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ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT--ETC F/8 5/1  
TERMS OF REFERENCE AND TOPICS LISTS FOR AGARD PANELS AND AEROSP--ETC(U)  
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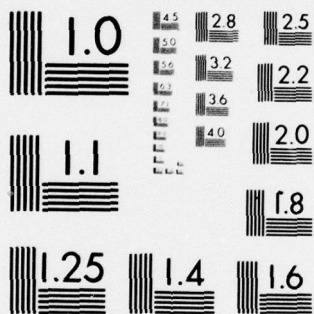
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AGARD

ADVISORY GROUP FOR AEROSPACE RESEARCH & DEVELOPMENT

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Terms of Reference and Topics Lists  
for  
AGARD Panels  
&  
Aerospace Applications Studies  
Committee

(Published September 1978)

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ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT

(ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD)

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**TERMS OF REFERENCE  
AND  
TOPICS LISTS  
FOR  
AGARD PANELS  
and  
AEROSPACE APPLICATIONS STUDIES  
COMMITTEE.**

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## THE MISSION OF AGARD

The mission of AGARD is to bring together the leading personalities of the NATO nations in the fields of science and technology relating to aerospace for the following purposes:

- Exchanging of scientific and technical information;
- Continuously stimulating advances in the aerospace sciences relevant to strengthening the common defence posture;
- Improving the co-operation among member nations in aerospace research and development;
- Providing scientific and technical advice and assistance to the North Atlantic Military Committee in the field of aerospace research and development;
- Rendering scientific and technical assistance, as requested, to other NATO bodies and to member nations in connection with research and development problems in the aerospace field;
- Providing assistance to member nations for the purpose of increasing their scientific and technical potential;
- Recommending effective ways for the member nations to use their research and development capabilities for the common benefit of the NATO community.

The highest authority within AGARD is the National Delegates Board consisting of officially appointed senior representatives from each member nation. The mission of AGARD is carried out through the Panels which are composed of experts appointed by the National Delegates, the Consultant and Exchange Programme and the Aerospace Applications Studies Programme. The results of AGARD work are reported to the member nations and the NATO Authorities through the AGARD series of publications of which this is one.

Participation in AGARD activities is by invitation only and is normally limited to citizens of the NATO nations.

## PREFACE

↙ The mission of AGARD, shown on the facing page, is conducted through its nine scientific and technical Panels, an Aerospace Applications Studies programme, and a Consultant and Exchange programme. *These report to* We are ~~here~~ concerned only with the first two of these activities.

Each AGARD Panel deals with a specific discipline or field of specialization within the broad spectrum of aerospace science and technology whereas the Aerospace Applications Studies Committee deals with systems-oriented studies which cross the boundaries of the disciplines of the individual Panels.

The delineation of the areas of activity of the various Panels is set out in their Terms of Reference which are presented in this Volume. These Terms of Reference, and accompanying Topics Lists, were first drafted by the Panels and the Aerospace Applications Studies Committee, then coordinated among the Panels, and finally officially approved by the AGARD National Delegates Board. ↗

It is hoped that the contents of this Volume will be useful not only to members of AGARD bodies but also to those who may participate or have an interest in AGARD activities.

*Robert H. Korkegi*

Robert H. Korkegi  
Director

# CONTENTS

1

	Page
PREFACE	iii
AEROSPACE MEDICAL PANEL (AMP)	
Terms of Reference	2
Topics List	3
AVIONICS PANEL (AVP)	
Terms of Reference	4
Topics List	5
ELECTROMAGNETIC WAVE PROPAGATION PANEL (EPP)	
Terms of Reference	6
Topics List	7
FLIGHT MECHANICS PANEL (FMP)	
Terms of Reference	8
Topics List	9
FLUID DYNAMICS PANEL (FDP)	
Terms of Reference	10
Topics List	11
GUIDANCE AND CONTROL PANEL (GCP)	
Terms of Reference	12
Topics List	13
PROPULSION AND ENERGETICS PANEL (PEP)	
Terms of Reference	14
Topics List	15
STRUCTURES AND MATERIALS PANEL (SMP)	
Terms of Reference	16
Topics List	17
TECHNICAL INFORMATION PANEL (TIP)	
Terms of Reference	18
Topics List	19
AEROSPACE APPLICATIONS STUDIES COMMITTEE (AASC)	
Terms of Reference	20
Topics List	21

## AEROSPACE MEDICAL PANEL (AMP)

### TERMS OF REFERENCE

The Panel is concerned with the participation of man in all aspects of aerospace operations. Specifically, the following subjects are covered:

- Anatomical, psychophysiological, behavioral and clinical effects of aerospace environment, that is, atmospheric factors such as hypo- and hyper-baric conditions, explosive decompression, toxic agents; dynamic factors such as linear and angular accelerations, vibrations, weightlessness; thermal factors and electromagnetic radiations, cosmic rays and high energy particles; other factors such as workload, fatigue, time zone shifts.
- Protection from adverse environmental factors such as control of cabin environment, personal protection equipment.
- Human factors such as aircrew anthropometry, flight deck ergonomics, man-machine systems, information processing capacity, visual and auditory presentation of information and its errors, aircraft ground control.
- Aircrew medical standards for selection, fitness and training, preventive medicine, hygiene, epidemiology,
- Accident aspects such as human factors, medico-legal investigations, accident prevention, escape systems, survival equipment and techniques.
- Biological experimentation in Aircraft and Space Vehicles including special experimental design and analysis, techniques for acquisition of biological and psychological data, life support systems.

The Aerospace Medical Panel coordinates especially with AVP, FMP and GCP in the field of man/machine integration and is the measure of the efforts of all other technical Panels.

**AEROSPACE MEDICAL PANEL****TOPICS LIST**

Code No.1

- 1.1 Anatomical, Physiological, Behavioural & Clinical Effects**
  - 1.1.1 Atmospheric Factors
  - 1.1.2 Mechanical Factors
  - 1.1.3 Thermal Factors
  - 1.1.4 Electromagnetic Radiation and High Energy Particles
  - 1.1.5 Workload (Mental and Physical)
  - 1.1.6 Rest and Activity Schedules and Time Zone Shifts
  - 1.1.7 Ageing, Drugs and Medication
- 1.2 Protection from Adverse Environmental Factors**
  - 1.2.1 Cabin Environment Control
  - 1.2.2 Personal Equipment
- 1.3 Escape and Survival**
  - 1.3.1 Seating, Restraint, Egress (Ejection)
  - 1.3.2 Deceleration Characteristics (Parachuting)
  - 1.3.3 Survival Equipment and Techniques
- 1.4 Human Factors**
  - 1.4.1 Aircrew Anthropometry
  - 1.4.2 Flight Deck Ergonomics
  - 1.4.3 Man-Machine Interface
  - 1.4.4 Auditory and Visual Presentation of Information
  - 1.4.5 Aircraft Controls
  - 1.4.6 Ground Control of Aircraft
- 1.5 Aircrew and Aeromedical Selection, Training and Medical Standards**
  - 1.5.1 Fitness Criteria for Aircrew, Passengers and Ground Personnel
  - 1.5.2 Aeromedical Implications of Disease or Disorder of Organs and Systems
  - 1.5.3 Pathophysiological Conditions Compatible with Flying ("Waivers")
- 1.6 Accidents and Incidents**
  - 1.6.1 Human Factors Aspects
  - 1.6.2 Pathological and Toxicological Investigation
  - 1.6.3 Medico-Legal Aspects
  - 1.6.4 Accident Prevention
- 1.7 Hygiene and Epidemiology**
  - 1.7.1 Aircraft Hygiene, Facilities and Decontamination
  - 1.7.2 Life in Closed Environments
- 1.8 Biological Experimentation in Aircraft and Space Vehicles**

## AVIONICS PANEL (AVP)

### TERMS OF REFERENCE

The Panel is concerned with all aspects of electronics research and development for aerospace systems. The overall objective is interpretation and implementation of military requirements for avionics systems. Specifically, the following subjects are covered:

- Navigation circuits and sub-systems to electronically implement inputs to and requirements for navigation systems.
- Detection Systems which include both microwave and optical active and passive systems.
- Communications, Information Processing, and Computer Technology, including theory, architecture, and implementing components, circuits, and systems.
- Aerospace and ground support equipment, including test, recording, power, and control systems.
- Advanced materials and components, including passive and active components and assemblies, validation and verification of design, and transducers.
- Systems engineering and management, including error detection and correction, integrity and availability of avionics systems and human factors.

The Avionics Panel coordinates its activities with the GCP and EPP in areas of mutual concern.

## AVIONICS PANEL

## TOPICS LIST

Code No.2

**2.1 Navigation**

- 2.1.1 Takeoff and Landing, Terminal
- 2.1.2 Enroute Navigation
- 2.1.3 Terrain-Following and Avoidance
- 2.1.4 Collision Avoidance
- 2.1.5 Satellite Navigation
- 2.1.6 Air Traffic Control

**2.2 Detection Systems — Active and Passive**

- 2.2.1 Surveillance
- 2.2.2 Reconnaissance
- 2.2.3 Mapping
- 2.2.4 Target Acquisition and Homing
- 2.2.5 Threat Warning and Countermeasures
- 2.2.6 Ranging
- 2.2.7 Tracking, Classification and Identification
- 2.2.8 Remote Sensing

*Note:* Among others, the technologies included in this topic are: radar/electro-optics/radiometry/infra-red/lasers/multi-spectral scanning.

**2.3 Information Processing and Computer Techniques**

- 2.3.1 Computer Hardware and Software Architecture
- 2.3.2 Artificial Intelligence (e.g., Decision Theory, Pattern Recognition, Game Theory)
- 2.3.3 Data Handling
- 2.3.4 Specialized Computer Languages

**2.4 Communications**

- 2.4.1 Air-to-Air
- 2.4.2 Air-to-Ground
- 2.4.3 Secure Systems
- 2.4.4 Satellite
- 2.4.5 Coding
- 2.4.6 Data Nets

**2.5 Aerospace and Ground Support Equipment**

- 2.5.1 Automatic Test Equipment
- 2.5.2 Flight Recording Systems
- 2.5.3 Secondary Power Systems
- 2.5.4 Automatic Flight Control Systems

**2.6 Advanced Materials and Components**

- 2.6.1 Passive and Active Components and Assemblies
- 2.6.2 Properties of Materials
- 2.6.3 Design Validation and Verification
- 2.6.4 High-Integrity Systems
- 2.6.5 Display Technology
- 2.6.6 Transducers

**2.7 Systems Engineering and Management**

- 2.7.1 Federated/Distributed/Centralized Systems
- 2.7.2 Fault Tolerance
- 2.7.3 Error Detection and Correction
- 2.7.4 Weapons Delivery
- 2.7.5 Flight Management
- 2.7.6 Flight Integrity and Availability
- 2.7.7 Maintenance
- 2.7.8 Human Factors

## ELECTROMAGNETIC WAVE PROPAGATION PANEL (EPP)

### TERMS OF REFERENCE

The Panel is concerned with all aspects of the propagation of electromagnetic and optical waves. Wave Physics, media effects, and interaction of waves with natural and man-made objects as they affect propagation are subjects of primary interest. The following specific areas are within the technical purview of the Panel.

- Ionospheric and Tropospheric Propagation which include structure, disturbances, scatter, absorption, and prediction and forecasting.
- Electromagnetic Propagation to include such items as noise effects, coherent and incoherent optical propagation, propagation in optical fibres, and antenna fields, patterns, and polarization as they affect radio propagation.
- Propagation aspects of systems which encompasses the full range of the influence which propagation effects exert on total system design.
- Ground characteristics which include interactions and effects of terrain, vegetation, and structures on propagation.
- Structures and dynamics of the propagation media in the earth environment.

The Electromagnetic Wave Propagation Panel coordinates primarily with AVP in areas of mutual interest.

## ELECTROMAGNETIC WAVE PROPAGATION PANEL

## TOPICS LIST

Code No.3

- 3.1 Structures and Dynamics of the Propagation Media in the Earth's Environment**
  - 3.1.1 Electromagnetic Characteristics of the Earth Surface
  - 3.1.2 Atmospheric Structure and Model Atmospheres
  - 3.1.3 Atmospheric Temperature, Density, Pressure and Moisture
  - 3.1.4 Winds
  - 3.1.5 Precipitation, Clouds and Aerosols
  - 3.1.6 Atmospheric Composition
  - 3.1.7 Atmospheric Electricity
  - 3.1.8 The Earth's Magnetic Field
  - 3.1.9 Ionospheric Physics
  - 3.1.10 Airglow and Aurorae
  - 3.1.11 Meteoric Phenomena
  - 3.1.12 Interplanetary Space and Its Properties
  - 3.1.13 Solar Electromagnetic Radiation
  - 3.1.14 Corpuscular radiation
  - 3.1.15 Acoustic Gravity Waves in the Terrestrial Atmosphere
- 3.2 Surface and Sub-Surface Propagation**
  - 3.2.1 Surface
  - 3.2.2 Sub-Surface
  - 3.2.3 Arctic
  - 3.2.4 Jungle
- 3.3 Tropospheric Radio Propagation**
  - 3.3.1 Line of Sight
  - 3.3.2 Atmospheric Absorption
  - 3.3.3 Millimeter Waves
  - 3.3.4 Scatter Propagation
  - 3.3.5 Duct Propagation
  - 3.3.6 Prediction
- 3.4 Ionospheric Radio Propagation**
  - 3.4.1 Ionospheric Structure
  - 3.4.2 Low and Very-Low Frequencies
  - 3.4.3 Medium Frequencies
  - 3.4.4 High and Very-High Frequencies
  - 3.4.5 Ionospheric Scatter
  - 3.4.6 Meteor Propagation
  - 3.4.7 Propagation in Arctic Regions
  - 3.4.8 Propagation in Equatorial Regions
  - 3.4.9 Ionospheric Radio Absorption
  - 3.4.10 Propagation Disturbances
  - 3.4.11 H.F. Predictions and Forecasting
- 3.5 Satellite Communications**
  - 3.5.1 Tropospheric Aspects
  - 3.5.2 Ionospheric Aspects
- 3.6 Optical Wave Propagation**
  - 3.6.1 Atmosphere Characterisation
  - 3.6.2 Incoherent Propagation
  - 3.6.3 Coherent Propagation
  - 3.6.4 Atmospheric Absorption Scattering
  - 3.6.5 Non-Linear Propagation
  - 3.6.6 Optical Fibre Propagation
  - 3.6.7 Propagation Aspects and Systems
- 3.7 Radio Noise**
  - 3.7.1 Noise Predictions
  - 3.7.2 Cosmic Noise
  - 3.7.3 Solar Noise Bursts
  - 3.7.4 Characteristics of Radio Noise
- 3.8 Antennas**
  - 3.8.1 Radiation fields
  - 3.8.2 Patterns
  - 3.8.3 Polarization
- 3.9 Frequency Spectrum Utilization**
- 3.10 Remote Sensing**

## FLIGHT MECHANICS PANEL (FMP)

### TERMS OF REFERENCE

The Panel is concerned with all aspects of the flight mechanics of aerospace vehicles.

Specifically, the following subjects are covered:

- Flight testing including such subjects as methodology, instrumentation, parameter identification and correlation.
- Flight dynamics including such subjects as performance, vehicle stability and control, handling qualities and advanced control concepts.
- Simulation including such subjects as facilities, mathematical models, environment, analyses and interpretation.
- Operational problems including such subjects as operational experience, safety, takeoff and landing, all-weather operations and low-altitude flight.

In addition, the Flight Mechanics Panel plays a unique role among the Technical Panels of AGARD by addressing the overall design and management problem and taking responsibility for coordinating the inputs of contributing Panels to such considerations as flight vehicle preliminary design, optimization and systems integration and has primary responsibility for the associated man-machine interfaces.

**FLIGHT MECHANICS PANEL****TOPICS LIST****Code No.4**

- 4.1 Flight Dynamics**
  - 4.1.1 Performance
  - 4.1.2 Stability and Control
  - 4.1.3 Handling Qualities (Analyses and Criteria)
  - 4.1.4 Ride Qualities
  - 4.1.5 Advanced Control Concepts
  - 4.1.6 Pilot/Aircraft Interface
- 4.2 Flight Testing**
  - 4.2.1 Methodology
  - 4.2.2 Instrumentation
  - 4.2.3 Experimental Design
  - 4.2.4 Parameter Identification
  - 4.2.5 Analyses and Interpretation
  - 4.2.6 Correlation (with Theory and Wind-Tunnel Data)
- 4.3 Simulation**
  - 4.3.1 Facilities
  - 4.3.2 Mathematical Models
  - 4.3.3 Experimental Design
  - 4.3.4 Cues, Simulation (Motion, Visual, etc.)
  - 4.3.5 Environment Simulation (Turbulence, Noise, etc.)
  - 4.3.6 In-Flight Simulation
  - 4.3.7 Analyses and Interpretation
- 4.4 Operational Problems**
  - 4.4.1 Operational Experience
  - 4.4.2 Safety
  - 4.4.3 Meteorological Effects on Flight
  - 4.4.4 Take-Off and Landing
  - 4.4.5 Launch and Recovery
  - 4.4.6 All-Weather Operations
  - 4.4.7 Low-Altitude Flight
- 4.5 Flight Vehicle Design and Integration**
  - 4.5.1 Preliminary Design
  - 4.5.2 Optimization
  - 4.5.3 Systems Integration

**FLUID DYNAMICS PANEL (FDP)****TERMS OF REFERENCE**

The Panel is concerned with enhancing our knowledge of the flow field of aerospace vehicles and improving their aerodynamic efficiency, as well as with applying fluid dynamics to other problems of potential military interest, the overall objective being to develop a strong technology base for the design of military systems. Specifically, the following subjects are covered:

- Aerodynamics and Fluid Mechanics, both fundamental and applied, including such items as viscous and inviscid flows, compressible and incompressible two- and three-dimensional flows, high enthalpy flows, attached and separated laminar-transitional-turbulent shear layers, and computational aerodynamics.
- Aerospace systems aerodynamics and stability and control parameters, including conventional, V/STOL and rotary wing aircraft, missiles, and unique or advanced concepts.
- Experimental facilities, techniques and instrumentation, including ground test facilities, full-scale and flight testing and measurement of mean and fluctuating flow properties.
- Aerodynamic noise, including noise generated by boundary layers, jets, fans, sonic boom, and test facility sources.
- Atmospheric fluid dynamics, including wind shear and turbulence, icing, and pollution.
- Industrial fluid dynamics, including aerodynamics of buildings and bridges, wind-power generation and fluidics.

Coordination and mutual assistance is maintained primarily with the FMP, SMP and PEP in those research areas where there is a complementary interface.

# FLUID DYNAMICS PANEL

## TOPICS LIST

Code No.5

- 5.1 Aerodynamics and Fluid Mechanics: Fundamental and Applied**
  - 5.1.1 Viscous and Inviscid Flows (Steady and Unsteady), Flow Interactions
  - 5.1.2 Compressible and Incompressible Flows
  - 5.1.3 Subsonic, Transonic, Supersonic and Hypersonic Flows
  - 5.1.4 One-, Two- and Three-Dimensional Flows
  - 5.1.5 Attached and Separated (Steady and Unsteady) Laminar, Transitional, and Turbulent Shear-Layers
  - 5.1.6 Turbulence, Navier-Stokes Equations
  - 5.1.7 Computational Aerodynamics/Fluid Mechanics
  - 5.1.8 Multiphase Flows, Reactive Flows, MHD
  - 5.1.9 Gasdynamic Lasers
  - 5.1.10 Shock Waves, Interactions, Detonations, Wave Propagation
  - 5.1.11 Heat Transfer, Combustion, Radiation, Ablation, Phase Changes
  - 5.1.12 Flow Over Vehicle Configurations; Wings, Control Surfaces, Fuselages, Component Interactions, Stores, etc.
  - 5.1.13 Internal Flows; Inlets, Ducts, Pipes, Ballistics
  - 5.1.14 Propellers, Fans, Cascades
  - 5.1.15 Hydrodynamics, Hydrofoils
- 5.2 Aerospace Systems Aerodynamics, Stability and Control Parameters**
  - 5.2.1 Conventional, V/STOL, Rotary Wing Aircraft
  - 5.2.2 Air-Cushion Vehicles
  - 5.2.3 Rockets, Missiles, Re-Entry Vehicles
  - 5.2.4 Remotely Piloted Vehicles (RPV's)
  - 5.2.5 Control Configured Vehicles
  - 5.2.6 Space Shuttle, Advanced Concepts
- 5.3 Experimental Facilities**
  - 5.3.1 Windtunnels (Conventional and Cryogenic), All Speed Regimes, Continuous and Intermittent Flow
  - 5.3.2 Other Ground Test Facilities (Impulse Tunnels, Ballistic Ranges, Water Tanks, Low-Density Tunnels, etc.)
  - 5.3.3 Full-Scale and Model Flight Tests
  - 5.3.4 Computers and Simulators
- 5.4 Experimental Techniques, Instrumentation, Measurement**
  - 5.4.1 Static Forces and Moments
  - 5.4.2 Pressure, Temperature, Density, Velocity (Mean and Fluctuating)
  - 5.4.3 Critical Flow Parameters (Heat Transfer, Skin Friction, Local Flow Angle, etc.)
  - 5.4.4 Non-Intrusive Instrumentation Methods, Flow Visualization
  - 5.4.5 Dynamic Stability, Magnus Effects
  - 5.4.6 Data Acquisition, Recording, and Reduction Systems
  - 5.4.7 Balances, Transducers, Calibration Methods
  - 5.4.8 Model Design and Construction
  - 5.4.9 Model Support, Interference, Distortion
  - 5.4.10 Tunnel Flow Quality, Interference
- 5.5 Aerodynamic Noise**
  - 5.5.1 Boundary-Layer Noise
  - 5.5.2 Jet Noise
  - 5.5.3 Fan Noise
  - 5.5.4 Sonic Boom
  - 5.5.5 Tunnel Noise Sources
- 5.6 Atmospheric Fluid Dynamics**
  - 5.6.1 Atmospheric Modeling: Wind Shear, Turbulence, etc.
  - 5.6.2 Pollution of Air, High Altitude and Low Altitude (also Ground and Water)
  - 5.6.3 Free Fires, Smoke Screens
  - 5.6.4 Effect of Atmospheric Stability
  - 5.6.5 Icing Prediction, Control
- 5.7 Industrial Fluid Dynamics**
  - 5.7.1 Aerodynamics of Buildings, Bridges, Power Lines, Ship Superstructures, Cars, Trucks, Trains
  - 5.7.2 Wind Power Generation
  - 5.7.3 Fluidics
  - 5.7.4 Gas and Hydrostatic Bearings
  - 5.7.5 Application of Unique Instrumentation

## GUIDANCE AND CONTROL PANEL (GCP)

### TERMS OF REFERENCE

The Panel is concerned with the theory and technology involved in closed loop control dynamics and elements for three principal mission functions:

- Navigation: the determination of the state (i.e., position, velocity, acceleration) of an aerospace vehicle.
- Guidance: the determination of the difference between the actual vehicle state and a desired vehicle state.
- Control: the generation and implementation of commands which drive the vehicle to the desired state.

Specific tasks involved in these functions include the direct measurement or estimation of the vehicle flight path and velocity using ground-based and on-board systems, the derivation of desired vehicle flight profiles, the computation of the vehicle deviation from these profiles, the definition of control commands to reduce or eliminate these deviations and the mechanization and instrumentation of these functions.

The scope of applications addressed by the Panel comprise ground command and control, air traffic control, global and local navigation, inertial and relative guidance, weapons delivery, terrain-following guidance and navigation and their impact on aerospace vehicle design and mission.

The closed loop dynamics and requirements for these mission functions require that the Guidance and Control Panel interact with a number of other AGARD Panels: with FMP for vehicle dynamics, design, analysis and synthesis of flight vehicle inner control loops, the associated man-machine interactions and vehicle trajectories; with AVP for electronic technology and components used in sensor and control system implementation; with SMP for structural dynamics, and load prediction techniques; AMP for pilot workload and dynamic interaction.

**GUIDANCE AND CONTROL PANEL****TOPICS LIST**

Code No.6

**6.1 Operational Systems of Navigation, Guidance and Control**

- 6.1.1 Air Traffic Control
- 6.1.2 Air Defence Control
- 6.1.3 Terrain Following
- 6.1.4 Airborne Collision Avoidance
- 6.1.5 Weapon Aiming and Delivery
- 6.1.6 Aircraft Landing
- 6.1.7 System Simulators
- 6.1.8 Command or Control

**6.2 Navigation and Guidance Systems, Techniques and Components**

- 6.2.1 Celestial Navigation
- 6.2.2 Satellites
- 6.2.3 Ground-Based Systems (Radio Location)
  - (a) Long-Distance Aids
  - (b) Medium-Distance Aids
  - (c) Distance-Measuring Methods
  - (d) Distance-Measuring Systems
  - (e) Special Aids
- 6.2.4 Autonomous Systems
  - (a) Doppler and Related Techniques
  - (b) Conventional Inertial Systems and Components
  - (c) Strapdown Inertial Systems and Components
- 6.2.5 Surveillance and Radar Data Processing

**6.3 Systems Techniques and Components**

- 6.3.1 Coupling of Guidance and Navigation to Vehicle System and Sub-Systems
- 6.3.2 Integrity and Reliability of Control System
- 6.3.3 Control Laws
- 6.3.4 Control System Techniques and Components

**6.4 Visualization Techniques**

- 6.4.1 Electronic Displays
- 6.4.2 Application of Electro-Optical Sensors
- 6.4.3 Flight Instruments
- 6.4.4 Special Applications

## PROPULSION AND ENERGETICS PANEL (PEP)

### TERMS OF REFERENCE

The Panel is concerned with all aspects of aerospace propulsion systems like airbreathing engines, including auxiliary on-board power generation units, solid and liquid propellant rockets, and nuclear and electrical systems. The concern includes the necessary energy release and conversion processes. In the field of gas turbines interest is extended beyond aerospace application to naval and land vehicle propulsion.

Specifically, the following subjects are covered:

- Combustion and Fuels, including the pertinent parts of fluid dynamics like turbulent mixing, chemistry, particularly reaction kinetics, and thermodynamics. Fuels and lubricants as used in airbreathing engines and propellants employed in rockets are covered as well.
- Fluid and Gas Dynamics, focussing on internal flows as envisaged in the components of turbine engines: inlets, compressors, combustors, turbines, afterburners and nozzles, including through flows in steady, transient and unsteady states, secondary flows, boundary layers, turbulent transport and heat transfer phenomena, external losses, aeroelasticity and noise.
- Engineering of Aerospace Propulsion Systems, comprising the design, development, operation and maintenance of these systems, including mission analysis and requirements, selection of cycles, analysis of loads, stresses, vibrations, and transient thermal effects, materials application and requirements, environmental aspects like noise and pollution, life cycle and maintenance costs, engine control, reliability, and integration.
- Propulsion Test Facilities and Relevant Measurement Techniques, including the development of new measuring systems and of test facilities which are capable of simulating up to actual environmental conditions, both for complete engines and for components, and which allow testing of typical cycles of engine operation.

The Propulsion and Energetics Panel coordinates with the other AGARD Panels and assists more frequently FMP, FDP, and SMP, both in Technical Meetings and in Working Groups.

## PROPULSION AND ENERGETICS PANEL

### TOPICS LIST

Code No.7

- 7.1 Thermodynamics and Combustion**
  - 7.1.1 Fundamental research in high-temperature reactions, aerothermochemistry, combustion and flames
  - 7.1.2 Applied research in high-temperature reactions, aerothermochemistry, combustion and flames
  - 7.1.3 Fundamental and applied research into heat transfer (cooling of components; heat exchangers, etc.)
- 7.2 Chemistry**
  - 7.2.1 Fundamental research of interest to aerospace propulsion systems
  - 7.2.2 Fundamental and applied research related to energy storage and conversion systems
- 7.3 Physics, Including Plasma Physics**
  - 7.3.1 Fundamental research related to aerospace propulsion systems
  - 7.3.2 Fundamental research related to energy storage and conversion systems
- 7.4 Aerodynamics and Fluid Mechanics**
  - 7.4.1 Fundamental research related to flow in inlets, ducts, turbomachinery and exhausts of aerospace propulsion systems and to flow problems with integrated vehicle/propulsion systems
  - 7.4.2 Applied research related to flow in inlets, ducts, turbomachinery and exhausts of aerospace propulsion systems and to flow problems with integrated vehicle/propulsion systems
  - 7.4.3 Applied research related to flow through seals and passages, including air lubrication, air bearings and damped bearings.
- 7.5 Materials Applications and Requirements**
  - 7.5.1 Research related to application of various materials being used in aerospace propulsion systems, e.g.:
    - high-strength, light-weight materials and non-metallic compound materials
    - high-temperature, high-strength materials
    - heat resistant alloys and ceramics
    - non-corrosive materials
    - anti-corrosive coatings
  - 7.5.2 Methods of fabrication and test in view of materials applications in aerospace propulsion systems
- 7.6 Aerospace Propulsion Systems — Research, Development, Production and Operation**
  - 7.6.1 Airbreathing
  - 7.6.2 Liquid Propellant Rocket
  - 7.6.3 Solid Propellant Rocket
  - 7.6.4 Nuclear
  - 7.6.5 Electric
- 7.7 Propellants, Fuels and Lubricants for Aerospace Propulsion (Including Cryogenics)**
  - 7.7.1 Airbreathing
  - 7.7.2 Liquid Propellant Rocket
  - 7.7.3 Solid Propellant Rocket
  - 7.7.4 Nuclear
  - 7.7.5 Electric
- 7.8 Aerospace Energy Conversion Systems**
  - 7.8.1 Static
  - 7.8.2 Non-Static
- 7.9 Control Systems for Aerospace Propulsion and Energy Conversion Systems**
  - 7.9.1 Mechanical
  - 7.9.2 Hydraulic
  - 7.9.3 Electric
  - 7.9.4 Fluidic
- 7.10 Vehicle/Propulsion System Integration**
- 7.11 Propulsion Test Facilities, Instrumentation, and Data Processing**
  - 7.11.1 Airbreathing Aerospace Propulsion Systems
  - 7.11.2 Rocket Propulsion Systems
  - 7.11.3 Nuclear Aerospace Propulsion Systems
  - 7.11.4 Electric Aerospace Propulsion Systems
  - 7.11.5 Integrated Vehicle/Propulsion Systems
- 7.12 Environmental and Safety Aspects**
  - 7.12.1 Environmental Pollution by Aerospace Propulsion Systems
  - 7.12.2 Noise Pollution by Aerospace Propulsion Systems
  - 7.12.3 Safety Problems, Including Fuel Fire Safety in Aircraft
  - 7.12.4 Vulnerability to Damage (Foreign Objects, Birds, etc.; Combat)
- 7.13 Engineering**
  - 7.13.1 Fundamental and Applied Research in Mechanical Aspects of Aerospace Propulsion Systems
  - 7.13.2 Research Into Reduction of Life Cycle Costs of Aerospace Propulsion Systems

**STRUCTURES AND MATERIALS PANEL (SMP)****TERMS OF REFERENCE**

The Panel is concerned with all aspects of structural research and development for aerospace vehicles and of engineering materials for all aerospace systems with the overall objective of improving effectiveness and reducing cost. Specifically, the following subjects are covered:

- Structural loads and dynamics, including prediction of static and dynamic loads, aeroelasticity, testing and test methods.
- Design methodology, including overall structural design and the study of special design problems.
- Reliability and maintainability, including fatigue life prediction and testing, structural degradation and methods of inspection.
- Materials properties, concepts and processing including development and characterization of materials and methods of fabrication for structures, propulsion and other engineering systems.

The Structures and Materials Panel coordinates primarily with FDP and PEP in areas of mutual interest.

## STRUCTURES AND MATERIALS PANEL

## TOPICS LIST

Code No.8

**8.1 Materials Properties**

- 8.1.1 Brittle Materials
- 8.1.2 Ductile Materials
- 8.1.3 Composite Materials
- 8.1.4 Refractory Materials
- 8.1.5 Ceramics
- 8.1.6 Properties Testing
  - Tension, Compression, Torsion, Creep, Thermal, Electrical, etc.
- 8.1.7 Special Properties
  - Toxicity, Flammability, Energy Absorption, Ablation, etc.

**8.2 Materials Concepts and Processing**

- 8.2.1 Forming and Treating
  - Casting, Forging, Rolling, Machining, Powder Metallurgy, Heat Treating, Cutting, Perforating, Ageing, etc.
- 8.2.2 Coating
- 8.2.3 Joining
  - Welding, Brazing, Bonding, etc.
- 8.2.4 Metallic Fibres and Fabrics
- 8.2.5 Metallic Matrix Composites
- 8.2.6 Non-Metallic Composites, Fibres and Fabrics
- 8.2.7 In-Situ Composites
- 8.2.8 Design of Materials for Failure Resistance (Fatigue, Corrosion, Fracture, etc.)
- 8.2.9 Development of Material Properties (Strength, High-Temperature Operation, Crack Suppression, Phase Stability, etc.)

**8.3 Reliability and Maintainability**

- 8.3.1 Fatigue
  - Cyclic Loading, Load Monitoring, Load History, Cumulative Damage, etc.
  - Acoustic Fatigue, Thermal Fatigue, Creep Fatigue, Low Cycle Fatigue, Corrosion Fatigue, etc.
- 8.3.2 Fatigue Testing
  - Random Loading, Major Component/Total Aircraft Testing, Accelerated Testing, etc.
  - Load History Prediction, Fatigue Life Prediction, etc.
  - Standardization of Tests
- 8.3.3 Corrosion
  - Stress Corrosion, High-Temperature Corrosion, Rain Erosion at Supersonic Speed, etc.
  - Corrosion Prevention and Combat
- 8.3.4 Fracture Mechanics
  - Crack Initiation and Propagation
  - Fractography
  - Combat and Prevention of Fracture
- 8.3.5 Non-Destructive Inspection
  - Detection and Measurement of Cracks, Corrosion, Residual Stresses, etc.
  - NDI of Composites, Joints, Welds, etc.
  - Design Considerations
- 8.3.6 Friction and Wear
  - Fretting
- 8.3.7 Safety Factors

**8.4 Design Methodology**

- 8.4.1 Overall Aerospace Vehicle Structural Design and Analysis
  - Design Technology, Design Optimization, Computer Aided Design, etc.
- 8.4.2 Special Design Problems
  - Impact Damage Tolerance, Crashworthiness, Fire Safety, RPV Structures, Aircrew Protective Systems, NDI Considerations, Plastic Deformation Effects, etc.

**8.5 Structural Loads and Dynamics**

- 8.5.1 Structural Dynamics and Response
  - Unsteady Airloads, Unsteady Ground Loads (Runway Roughness), Aeroelasticity, Flutter, Vibration, etc.
- 8.5.2 Load Generation and Alleviation
  - Effects of Pilot Inputs, Dynamic Stability Effects, Environmental Effects (Gusts, Turbulence, Wind Shear, Temperature Distribution, etc.), Active Controls, Stability Augmentation, etc.
- 8.5.3 Loads Testing, Measurement, Prediction and Analysis
  - Strain Gauge Techniques, Testing Methods, Collection of Experimental Results and Failure Data (Load Histories, etc.), Load Predictions (Limit Loads, Load Spectra, etc.), Analytical Methods, Calculation Methods, etc.
- 8.5.4 Special Load Problems
  - V/STOL Loading, Helicopter Loading, RPV Loads, Carrier Environment Loads, Extraterrestrial Loads, Airship Loading, Missile Loads, External Stores Loads, etc.

## TECHNICAL INFORMATION PANEL (TIP)

### TERMS OF REFERENCE

It is an accepted fact that an effective scientific and technical information system will not only reduce the cost and time required for research and development by minimizing false starts and duplication of effort, but the quality of the R & D results will also be enhanced when the scientist or engineer has access to comprehensive information on all relevant work previously accomplished.

Therefore, the mission of the Technical Information Panel has three main elements:

- To assist NATO's aerospace research and development activities by improving the effectiveness of scientific and technical information systems throughout the member nations.
- To provide support to AGARD by producing dictionaries, glossaries, indexes to AGARD publications and bibliographies in support of Lecture Series, Conferences of special note and at the request of AGARD activities.
- To foster international cooperation and exchange among the NATO nations by bringing together as Panel Members, the leaders of the national defence documentation centres, and other agencies involved in the collection and dissemination of aerospace information.

**TECHNICAL INFORMATION PANEL****TOPICS LIST**

Code No.9

**9.1 Information Transfer and Utilization**

- 9.1.1 Information Centres and Libraries
- 9.1.2 Specialized Information Services and Systems
- 9.1.3 User Studies and Surveys
- 9.1.4 Government Systems
- 9.1.5 National and International Networks
- 9.1.6 Translations
- 9.1.7 Education and Training
- 9.1.8 Legal Aspects – Copyright

**9.2 Information Generation and Provision**

- 9.2.1 General
- 9.2.2 Writing and Recording
- 9.2.3 Editing
- 9.2.4 Printing – Conventional
- 9.2.5 Printing – Mechanized
- 9.2.6 Primary Sources
- 9.2.7 Economic Factors
- 9.2.8 Microreprographics

**9.3 Information Storage and Retrieval**

- 9.3.1 Indexing
- 9.3.2 Classifying
- 9.3.3 Cataloging
- 9.3.4 Abstracting
- 9.3.5 Authority Files
- 9.3.6 Storing and Updating
- 9.3.7 Searching
- 9.3.8 File Structures
- 9.3.9 Automated Systems
- 9.3.10 Linguistics
- 9.3.11 Secondary Publications (Announcement Services)

**9.4 Informatics**

- 9.4.1 Tests and Evaluations
- 9.4.2 New Developments and Concepts
- 9.4.3 Computers
- 9.4.4 Other

## AEROSPACE APPLICATIONS STUDIES COMMITTEE (AASC)

## TERMS OF REFERENCE

The Aerospace Applications Studies Committee, AASC, was established in 1971 to provide a mechanism for the organization, management and review of applications studies requested by the North Atlantic Military Committee which, because of their system nature, were inappropriate for the AGARD Technology Panel Programme.

Under the Military Committee Studies Programme, studies are performed of an *interdisciplinary systems nature that transcend the scope of the individual Technology Panels*. These studies, known as Aerospace Applications Studies (AAS), typically involve several technologies, systems analysis, and operational research and can be characterized as *systems applications of emerging technology to solve a military operational problem*.

As the list of study topics to date (see Topics List) suggests, diverse subjects involving any technologies can be selected for study. Technologies involved in AAS to date have included such diverse areas as flight mechanics, infrared propagation, electro-optical sensors, radar techniques, video-link remote control, air-to-air missile guidance and propulsion, satellite-based navigation techniques, laser tracking, spread-spectrum communications, optical frequency SAM guidance, real-time radio frequency transmission of photographs, detection of hidden targets, etc.

*Operational aspects* are also included in the studies, such as command and control constraints, limits on operational funding, political restrictions on tactics, as well as considerations of the potential threat.

As the AAS of the future can be of any selected subject of interest to the Military Committee, virtually any technology could be involved in a study and any aerospace system could be involved, e.g. aircraft – manned or unmanned; radars – radio or optical frequency; missiles – air-air, surface-air, or air-guidance systems – rf, laser, or other, and land-based, air-based, or space-based; and command, control and communications systems of all types.

## AEROSPACE APPLICATIONS STUDIES COMMITTEE

## TOPICS LIST

Code No.10

- 10.1 Physical Vulnerability of Aircraft  
(AR-47)\*
- 10.2 Small Tactical Missiles for 1980 and Beyond  
(AR-57)
- 10.3 Detection of Sheltered and Dispersed Aircraft  
(AR-59)
- 10.4 Unmanned Aircraft  
(AR-79)
- 10.5 Night Vision Devices on Fast Combat Aircraft  
(AR-73)
- 10.6 Use of Precision Positioning Systems by NATO  
(AR-88)
- 10.7 Suppression of Radars Associated with SAMs  
(AR-91)
- 10.8 Interception of Mach 3 Aircraft by Fighters
- 10.9 Advanced Technology to Counter Low-Altitude Threats
- 10.10 Communications Devices Supporting Air Warfare with Reduced Susceptibility to Jamming, Intercept, and Location Determination
- 10.11 Suppression of Detection and Guidance Systems, Other Than Radar, Associated With SAMs, ASMs and Guided Bombs

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